residue could be subjected to petrographic examination by the junior author.

The material was found to be very fine, ranging in size of grains from colloidal dimensions up to almost 0.15 mm. The largest mineral grain was of muscovite mica and measured 0.085×0.04 mm. One quartz grain was almost as large, but most of the quartz was much smaller. About 50 percent of the material (by volume) was less than 0.005 mm in diameter, less than 5 percent over 0.025 mm, and the remainder between those dimensions. Many of the grains below 0.01 mm in diameter could not be determined with the equipment available. The substances recognized in the sample, therefore, were limited principally to the larger grains and were as follows:

Approximate frequency (W) among grains larger than 0.01 mm in diameter

Volcanic glass	56
Quartz	17
Opaque grains, probably ashes and carbonaceous materials	10
Clay grains, mostly aggregates, in part weathered glass	5
Muscovite	5
Diatoms, several species, fresh-water types	2
Feldspars (undifferentiated) chiefly plagioclases	1

Less than 1 percent but fairly common

Chlorite
Biotite
Microcline
Orthoclase
Hematite and limonite
Calcite, as aggregates and as cleavage fragments

Rare

Epidote, several grains
Zircon, 2 grains
Spherulites
Sponge spicules (?)
Titanite (?), one grain

The volcanic glass varies from colorless to brown, with a variety of shapes: irregular flat grains, curved fragments of bubble walls, grains including one or more bubbles, minute pumice fragments, and rod-shaped grains. Such shapes are typical of glass *shards*, blown from a volcano, and would hardly result from the weathering of glassy lavas. The largest grain of glass measured 0.14×0.098 mm. and a triple bubble 0.075×0.045 mm.

The highest percentage of volcanic glass does not necessarily mean that the dust came from an area where tuffs make up a large proportion of the surface outcrop. The relatively low specific gravity of the material and, especially, the shapes of the grains tend to concentrate glass fragments in finer dust, as heavier and more equidimensional grains settle out. Even a small percentage of volcanic glass in the soils from whence the dust originated would account for a high percentage of the material in dust drifted long distances.

The grains less than 0.005 mm in diameter apparently include less glass than the coarser sizes. Although the very finest material could not be definitely determined, it apparently consists largely of colloidal clay particles.

While the mineralogical analysis of the dust does not furnish a basis for the specific identification of the area of origin it strongly suggests, on the basis of rather uniformly very fine size and high percentage of volcanic glass, that the source was remote, and the direction of drift of the air mass which contained the dust points toward the Plains States as the source region.

ANALYSIS OF THE PRECIPITATION OF RAINS AND SNOWS AT MOUNT VERNON, IOWA

By NICHOLAS KNIGHT

[Cornell College, Mount Vernon, Iowa, June 25, 1934]

In our work on the rains and snows for 1933–34, we treated 43 specimens of which 8 were snow and 35 were rain. The entire period was unusually dry. The precipitation for April was only one-eighth normal and some other months showed almost the same lack of moisture. The rain of May 9 was at the time of a heavy dust storm from the northwest and the bottom of the pans in which the water was collected for analysis was covered with a thick layer of black mud. There were a number of dust storms during the winter and spring. The rains of May and June, as a rule, were accompanied by severe thunder and lightning.

TABLE 1.—*Nitrogen and chlorine in rain and snow (parts per million)*

Date	Precipitation in inches		Chlorine	Free amm.	Alb. amm.	Nitrate	Nitrite	Sulphate SO_3
	Rain	Snow						
1933								
June 22	0.5		11.15	0.056	0.056			
23	.45		3.55	.040	.112			
Sept. 24	.25		7.10	.20	.136		0.001	
26	1.15		7.10	.32	.112		.0014	
Oct. 8	.47		7.10	.272	.16		.002	
10	.2		7.10				.0021	
15	.25		3.55	.36	.28		.012	
17	.2		7.10			0.2	.0193	
21	.2		3.55	.72	.112	.144	.012	
26	.42		17.75			.688	.012	23
Nov. 2	.10		3.55			.176	.155	15
5		4	3.55	.32	.72	.10	.005	8
25		1	17.75					

TABLE 1.—*Nitrogen and chlorine in rain and snow (parts per million)*—Continued

Date	Precipitation in inches		Chlorine	Free amm.	Alb. amm.	Nitrate	Nitrite	Sulphate SO_3
	Rain	Snow						
1933								
Dec. 3	0.65		2.13	0.02	0.28	0.06	0.0035	3.8
10		2	3.55	.28	.16	.078	.005	
25		4	1.42	1.12	.056	.062	.0032	6
1934								
Jan. 4	.5		.71	.24	.08	.08	.02	6.8
12	.2		3.55	.32	.045	.18	.014	7.6
Feb. 16		2	7.10	.36	.56		.0084	
18	.4		3.55	.24	.72		.0146	5
24		3	11.15	.72	1.2	.12	.006	14
Mar. 2	.2		.71	.80	.32	.131	.012	12
3	.1		3.55	.05	.85	.13	.0092	15
6	.25		1.42	.04	.72		.0092	10
9		1	7.10			.01	.0071	
17	.4		3.55	.40	.36	.192	.19	10
23		2	1.42	.32	.136	.150	.053	
30	.1		3.55			.450	.0258	50
30	.2		3.55			.496	.014	17
Apr. 1	.5		3.55	.16	.36		.0121	
4	.2		.71	.48	.16	.12	.01	28.5
26	.12		2.13			.21	.0017	10
May 9	.10		10.65			.3	.02	10
13	.6		3.55	.72	.36	.3	.005	
21	.12		3.55	1.44	1.12	.1	.1	4.1
24	.12		3.55	1.80	.64	.01	.02	0
June 5	.80		10.65	.36	.32	.20	.025	0
6	.50		3.55	.32	.20	.20	.030	0
8	1.00		3.55	.08	.36	.20	.035	0
9	.15		1.42	.48	.16	.20	.035	0
14	.25		2.13	.42	.136	.2	.38	0
17	.08		.23			.0018	.004	
20, 22	.65		3.55	.16	.12	.1	.04	0

TABLE 2.—*Nitrogen and chlorine in rain and snow (pounds per acre)*

Date	Precipitation in inches		Chlorine	Free amm.	Alb. amm.	Nitrate	Nitrite	Sulphate SO_3
	Rain	Snow						
1933								
June 22	0.5		1.27	0.0064	0.0064			
25	.45		.37	.002	.011			
Sept. 24	.25		.40	.011	.008		0.00006	
26	1.15		1.85	.084	.029		.00036	
Oct. 8	.47		.77	.029	.017		.0002	
10	.2		.32					
15	.25		.20	.02	.0159		.0007	
17	.2		.32			0.009	.0009	
21	.2		.81	.03	.005	.007	.0001	
26	.12		.48			.02	.0003	0.63
Nov. 2	.10		.08			.004	.00035	.34
5		4	.27	.025	.055	.008	.00046	.6
25		1	.34					
Dec. 3	.65		.32	.003	.04	.023	.0005	.60
10		2	.136	.011	.006	.003	.00023	
25		4	.106	.0084	.004	.0048	.0025	.45
1934								
Jan. 4	.5		.081	.027	.009	.009	.002	.77
12	.2		.16	.036	.002	.009	.0007	.21
Feb. 16		2	.27	.0134	.0021		.00032	
18	.4		.32	.081	.066		.0011	.45
24		3	.64	.055	.068	.007	.0003	.79

TABLE 2.—*Nitrogen and chlorine in rain and snow (pounds per acre)*—Continued

Date	Precipitation in inches		Chlorine	Free amm.	Alb. amm.	Nitrate	Nitrite	Sulphate SO_3
	Rain	Snow						
1934								
Mar. 2	0.2		0.032	0.036	0.014	0.0059	0.0006	0.54
3	.1		.08	.0011	.019	.0002	.0002	.34
6	.25		.79	.002	.041		.0005	.57
9		1	.013			.00014	.000136	
17	.4		.32	.036	.032	.0018	.0017	.91
23		2	.55	.012	.005	.0057	.0021	
30	.1		.08			.01	.0006	1.14
30	.2		.16			.22	.0006	.76
Apr. 1	.5		.4	.018	.041		.0002	
4	.2		.003	.02	.007	.0055	.0005	1.31
26	.12		.058			.006	.0005	.27
May 9	.10		.24			.0068	.0044	.23
13	.65		.15	.05	.025	.045	.0075	
21	.12		.097	.04	.03	.003	.0004	.11
24	.12		.097	.05	.017	.003	.006	
June 5	.80		1.92	.065	.058	.036	.0045	0
6	.50		.40	.036	.023	.023	.0034	0
8	1.00		.8	.02	.08	.04	.08	0
9	.15		.48	.016	.005	.007	.001	0
14	.25		.121	.024	.008	.01	.002	0
17	.08		.123			.0018	.004	
20, 22	.65		.52	.02	.018	.015	.059	0

CIRCULATION IN THE STRATOSPHERE OVER BRAZIL

By ADALBERTO B. SERRA

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(Translated by A. R. Stickley)

The aerological observations in Brazil have rarely attained the height of 12 kilometers, in spite of the regularity with which they have been taken since 1921.

Only about a hundred soundings above this level have been effected over the whole country during the 12 years of operation of the Aerological Service. It is therefore impracticable to represent the results obtained by means of graphs or tables. Consequently, we shall only make a summary in the form of a simple commentary.

The level of 12 kilometers is in the stratosphere only over the southern part of the country. At the Equator, this height is within the troposphere, which there extends to about 15 kilometers above sea level. Thus the lower of the levels which we shall now discuss do not belong to the stratosphere in the equatorial zone. The layers to be studied are three: (*a*) from 12 to 15 kilometers; (*b*) from 15 to 20 kilometers; (*c*) above 20 kilometers. The periods are two: (*a*) winter (April to September, inclusive) and (*b*) summer (October to March, inclusive), corresponding respectively to the positions of the sun north and south of the equator. These data were furnished by the following stations: (*a*) in the Atlantic Ocean: Fernando Noronha; (*b*) along or near the coast: Quixeramobim, Olinda, Maceio, Sao Salvador, Victoria, Campos, Rio de Janeiro, Mendes, Sao Paulo dos Agudos, Curityba, and Porto Alegre; (*c*) in the interior of the continent: Cuyaba. We have arrived in this way at the following conclusions:

From 12 to 15 kilometers elevation the winds vary during summer from SE. to NW. through S. Along the coast there is a marked predominance from SE. to S. which appears to constitute the higher zone of the trade winds of the Southern Hemisphere. However, at Cuyaba, they come mainly from the W. to NW.

The winds are also the same during the winter, except at Fernando Noronha where they blow exclusively from the W. to NW. and at Cuyaba where, notwithstanding the reported currents from SE. to S, the most frequent are also those from the W. to NW.

From 15 to 20 kilometers, the winds blow from the SE. to NE. during the summer, except at Porto Alegre where they come from the south and at Cuyaba where they blow from SE. to W.

On the coastline, in winter, the circulation is from SE. to SW., except at Fernando Noronha, where there also are winds from the NW.

Beyond the 20-kilometer level, the circulation is exclusively from the ENE. to ESE., which seems, moreover, to be generally true for the whole region. The speeds vary in the two lower layers from 7 to 15 meters per second. However, not infrequently there are in this region light winds of from 1 to 2 meters per second and, very rarely, those of even greater speeds than 15 meters per second.

Beyond 20 kilometers there are winds of greater than 20 meters per second. The maximum to date is about 42 meters per second.

It is seen then that in the layers discussed, winds from the NW. to NE. sector rarely occur. Up to 20 kilometers, the circulation is generally from the south with easterly or westerly components—winds from the NE. to E. or from the NW. to W. being noted very rarely. The latter are, however, more frequent at Fernando Noronha and at Cuyaba. The circulation is always from the east beyond 20 kilometers.

These pilot-balloon observations are the only source of real information which exists concerning the circulation in the stratosphere over the Brazilian coast, and, despite their rarity, are preferable to hypotheses based only on surface observations.